ISSN 0018-151X, High Temperature, 2017, Vol. 55, No. 3, pp. 469–471. © Pleiades Publishing, Ltd., 2017.
Original Russian Text © D.A. Gubaidullin, R.G. Zaripov, L.A. Tkachenko, L.R. Shaidullin, 2017, published in Teplofizika Vysokikh Temperatur, 2017, Vol. 55, No. 3, pp. 484–486.

SHORT COMMUNICATIONS

Experimental Study of Coagulation and Sedimentation of Gas-Particle Suspension in Closed Tube under Transfer to the Shock-Wave Regime

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Received July 12, 2016

Abstract—The peculiarities of efficient coagulation and sedimentation of fine-dispersed gas-particle suspension are investigated experimentally at oscillations near the first eigenfrequency in a closed tube at transfer to the shock-wave regime under low excitement amplitudes. We obtain the temporal oscillograms of the gas-particle suspension pressure near the piston: in the resonance, the oscillograms are close to bursting but retain a continuous mode. The dependences are obtained for coagulation and sedimentation duration on the piston displacement amplitude and frequency.

DOI: 10.1134/S0018151X17030099

INTRODUCTION

Ecology problems of atmosphere polluted by blow-outs of gas with fine particles (gas-particle suspension) from various industrial objects (gas with particles occurring at fuel burning at power stations, in cement ovens; water vapor and other liquids in heat engineering facilities, e.g., in cooling stacks) are currently very relevant. The usual means of particle removal (electrofilters, cyclones, etc.) are hardly effective for fine particles with sizes below a micrometer. Acoustic coagulation [1] or aggregation and confluence of the fine gas-particle suspension particles with those larger and with each under the wave field action result in an enhancement of gas purification efficiency. Thus, studies of the wave dynamics of nonuniform and multiphase media are of sufficient interest due to their application trends [2, 3]. Problems and features of studies of the two-phase flows with solid particles, droplets, and bubbles as well as the mechanisms of formation of domains with enlarged disperse phase concentration in such flows are considered in [4–6]. The authors of [7–13] considered, in their experimental works, the nonlinear gas-particle suspension (aerosol) oscillations near resonance frequencies in tubes with various conditions at the ends. Oscillations in the shock-free and the shock-wave regimes were accompanied by coagulation of engine oil and tobacco smoke droplets (1–10 μm) [7], oleic acid droplets (1–10 μm) [8], smoke particles obtained from incense stick burning (0.3 μm) [9], and droplets from the di-ethyl-hexyl-sebacate liquid (0.863 μm) [10–13].

The present study is a continuation of the works [10–13] and adds to the results on coagulation and sedimentation of fine-disperse gas-particle suspension at oscillations near the first eigenfrequency in a closed tube already in the regime of transfer to the shock waves under low excitement amplitudes.

EXPERIMENTAL FACILITY

We performed experiments on the new experimental facility (Fig. 1) based on the *6* TIRAvib S 5220/LS (Denmark) vibro-stand with a BAA 1000-ET power amplifier and cooling fan. A bar is screwed into the vibro-generator table; it drives piston *4*, moving in the cylinder located on bedding with a lower mouth-piece. The bedding is installed on the four buckles screwed into the vibro-stand basement. Glass tube *1*, $2R = 0.1$ m in diameter, is glued onto the upper and the lower mouth-pieces and is maintained vertically by means of the buckles attached to it. Cap *8* is hermetically attached to the upper mouth-piece with bolts. Total tube length from the piston to the upper mouth-piece is $L = 0.938$ m. The vibrator is controlled by the 4513 Bruel & Kjaer (Denmark) piezoelectric IEPE accelerometer *5* and the Vibration Research 9500 (USA) controller via special VibrationVIEW software support installed in the PC. The values of frequency, ν, and the piston displacement amplitude, $2l$, are preset with an accuracy of 10^{-6} Hz and 10^{-7} m, respectively. The 8530C-15 Bruel & Kjaer pressure gauge *3*, 5 mm in diameter, is screwed into the hole in the lower mouth-piece; its signal is fed, via the ENDEVCO-136 Bruel & Kjaer three-channel bridge voltage amplifier, to the